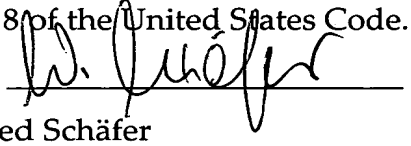
VERIFICATION OF TRANSLATION

I, Wilfried Schäfer, with a post office address of Vormholzer Ring 75 B, 58456 Witten, Germany, an official technical translator, hereby certify that the following English text is a full, accurate and true translation of the accompanying German language text headed "Ventil" and I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

By 

Wilfried Schäfer

Executed this 22nd day of September 2004.

RTHR0375 (167/03)
D12/D4201
AK/ch

Valve

The invention relates to a valve primarily intended for discharging foaming agents from pressurized containers with said valve sealing off the pressurized container to the outside and being provided with an outlet opening equipped with a movably arranged closure part retained in closed position by means of a spring element and, when actuated externally, clearing an outlet opening for the foaming agent present in the pressurized container, said valve being mounted on a container cover designed to function as a valve disk.

Foams for mounting purposes, in particular polyurethane foams, are widely used for all kinds of industrial applications. In the building and construction industry they serve to secure elements such as door frames and other prefabricated components, seal openings, fill hollow spaces and pockets with foam. More often than not they are used for thermal and sound insulation purposes. Moreover, they are suited to fill hollow spaces and thus prevent the formation of condensate that may cause corrosion problems. For the same reasons, mounting foams are increasingly employed in automotive engineering applications.

The frequently used one-component polyurethane foams are produced when the prepolymer present in the pressurized container is brought into contact with moisture, in particular air humidity. As soon as the mixture of propellant and foaming agent has been released a reaction occurs between the prepolymer and the moisture contained in the air. This leads to the formation of a durable foam. Depending on the atmospheric humidity content curing takes place within

a relatively short period of time. If air humidity is high curing will take just a few minutes. The same applies to silane terminated polyurethane foams. In the event of 1.5 and 2-component foams a separate cross-linking component is additionally provided in the pressurized container.

Special valves serve to discharge or expel the foam with said valves clearing the foam path in that they are tilted or pushed down. During handling and intermediate storage, however, they must reliably seal off the system. Should such sealing action prove to be insufficient moisture will diffuse into the valve mechanism causing the prepolymers in the valve to harden and impair the correct functioning of the valve. In the worst case the valve will be blocked completely as a result of the polymer that has formed inside.

There are special valves arranged in the top or dome section of such a pressurized container and retained with the aid of a rubber seal. By bringing the valve tube or stem into an inclined position the foam is allowed to enter the tube via rubber seal and hollow tube cover plate and through recesses provided for this purpose in the tube wall and in this manner exit the pressurized container.

Although these tilting valves are provided with a relatively good sealing mechanism the tilting movement required to release the prepolymer propellant mixture is generally considered a disadvantage. Discharging the mounting foam in a well-aimed manner is difficult as the discharge direction of the mixture changes as a result of the tilting movement. Moreover, the tilting mechanism is hardly suited to make use of mechanical discharging aids such as spray guns. Since the valve tube is free to turn in its seal it attempts to avoid the tilting movement by performing a rotating movement.

Furthermore, disk valves are known that provide for a valve closure element to be joined via a coil spring to a retaining part serving as abutment. The retaining part is allowed to freely project into the interior of the pressurized container. The spring is mounted between retaining part and valve closure element securing it firmly on the valve disk. Retaining part and spring are fully accessible to the media to be discharged. When actuating the valve closure element this mixture of propellant and prepolymer exits the pressurized container and thus enters the

area where spring and its retaining part are located. As the pressure acting on the valve closure element decreases said element is again pressed against the valve disk thus preventing the mixture from exiting any further. Mixture still present in the valve space will be discharged through action of the propellant content.

Disk valves of this type with spring mechanism are well suited for connections to spray guns. Nevertheless, they have a disadvantage in that the function of the spring is impaired or even blocked sooner or later because moisture diffuses into the valve mechanism and causes polymer formation. This leads to the pressurized container being unable to discharge in a controlled manner or becoming leaky and blowing off irregularly.

In another version of such valves sealing sections are arranged over the circumference of the valve closure element. These comprise of at least one elastically deformable disk-shaped section projecting radially from the closure element and becoming deformed when contacting the valve seat. Sealing and closure elements are of 'monolithic' design and thus made of the same material. In the interest of deformability these elements need to be elastic to some extent which puts a limitation on the contact forces applied and thus reduces tightness.

All these valves are of rather sophisticated design including numerous details, among which there is a rigid valve body to be attached to or molded on the valve disk. To bring down the costs a simple construction associated with fewer individual parts would be desirable.

Therefore, object of the invention is to provide a valve that does away with the above described disadvantages customary valves suffer. Said valve shall prevent moisture from entering the valve space situated within the pressurized container. Nevertheless, the design must enable discharge aids such as spray guns to be connected. The valve should be of simple construction and provide a high degree of operational safety.

To achieve this objective and based on the valve type described hereinbefore the invention proposes that the valve disk has a sealing face designed to act as

valve seat with said sealing face interacting with a sealing element, and the valve disk and the sealing element being made of a rigid, functionally non-deformable material and the sealing effect being brought about by an elastic element arranged on the valve disk, and the spring element that holds the sealing element in closing position being directly secured to the valve disk.

The valve enables the pressurized container to be properly connected to a spray gun of customary design. Since the valve closure element is moved in pressurized container axis direction through the action of a valve shaft the function of the system is no longer impaired by a skewing movement.

Due to the fact that the valve closure element does not require elastically deformable details to perform its sealing function it may consist of a rigid material same as the valve disk. It is thus possible to provide for contact forces sufficient for the sealing effect and transmit said forces by the respective spring action. The sealing function is effected by separate elastic elements which are designed and proven for the task. Furthermore, the valve disk in its comprehensive function as cover for the pressurized container on the one hand and also as rigid valve body on the other offers the required strength to absorb the contact forces arising on the valve seat faces.

Based on the above described basic construction concept better solutions are available with respect to the arrangement of the springs used to reset the movable valve element serving for valve closure. In this way, the spring elements may be arranged in locations totally external to the space where the curing media exit, that is within the space on the valve disk off the pressurized container. In this location they exert pull forces on the movable valve element thus forcing it against the face of the valve seat. In this manner even helical springs do not run the risk of having their coils clogged up causing their correct functioning to be impeded.

Another preferred solution provides for a leaf spring to be permanently attached as elastic spring element to the side of the valve disk facing the pressurized container. Although in this position there is contact with the exiting fluid but said fluid is not yet in contact with media that have curing or hardening effects.

Moreover, as regards the flow of media they are favorably arranged on the valve closure element in a manner that allows media to pass easily. Such an arrangement is even more beneficial in that there is no retaining part for this spring element that might lead to a turbulent flow behavior in that critical area. A clogging or blocking is thus positively ruled out. Furthermore, leaf springs have fewer points or faces of contact or even none at all that are prone to be clogged up through the foaming agent.

Further preferred embodiments of the invention are the subject matter of subclaims dealt with in more detail on the basis of the attached figures. It is to be understood that the characteristics and designs shown and described in the preferred embodiments of the invention are not only of significance in the framework of the combinations shown but rather in any conceivable and reasonable combination and design configuration that may be derived from the entirety of the representations and descriptions given herein. The following is shown in the figures:

Fig. 1	is a section through a valve provided with a two-part valve closure element and a helical spring arranged in the valve disk on the side off the pressurized container,
Fig. 2	is a section through a valve provided with a two-part valve closure element and a leaf or disk spring attached to the valve disk on the side facing the pressurized container,
Fig. 3	is a section through a valve provided with a one-part valve closure part and a combination of a spring and sealing element attached to the valve disk on the side facing the pressurized container,
Fig. 4	is a section through another preferred valve embodiment where the elastic element for sealing purposes has been made into an elastic and sealing guide element,

Fig. 5 is a variant of the embodiments shown in Fig. 3, and

Fig. 5a is a perspective sectional view of the embodiment shown in Fig. 5,

Fig. 6 is a valve according to the invention provided with a separate sealing element retained by a leaf spring.

Fig. 1 shows a section through a valve according to the invention. Valve disk 1, 2 performs the functions as container cover and valve body. For this purpose it has a central opening 3 through which the movable valve closure element 4, 5 passes, valve seat faces 6 arranged in parallel to the expediently engaging sealing faces 7 on the valve closure element and a valve shaft 8 serving as guide for the valve closure element. With its inner diameter the valve shaft serves as sliding face for the seal 16 mounted by force fitting between the two parts 4, 5 of the valve closure element. With its outer diameter the valve shaft furthermore serves as a spring guiding structure for helical spring 9 acting on the bottom side of a shoulder 10 of the greater diameter of part 4 of the valve closure element located away from the pressurized container. In this manner the forces exerted by the non-compressed spring draw the movable valve element 4, 5 against the valve seat into the position required to close the valve and cause said element to be retained in this position.

To open the valve an external force acting against the force exerted by the spring must be applied to the movable valve element 4, 5. This will then result in an annular gap 11 being cleared between valve seat 6 and sealing face 7 on the valve closure element 4, 5. Through said gap the medium is allowed to exit the pressurized container via ducts 12, 13, 14 arranged inside the valve closure element and above its sealing face and from that point into or onto the structural components aimed at or through a spray gun which is not shown here. On side A of the figure the open position of the movable valve element is shown while side B shows its closed position.

For example, the two parts 4, 5 of the movable valve element in this variant are joined by means of a threaded connection 15. This causes an O ring 16 serving as sealing element to be compressed such that it is in sealing contact with the valve shaft 8. It is proposed to place on valve seat 6 an elastomeric washer 17 for sealing purposes. With respect to a spray gun that may be mounted the sealing element may also be an O ring 18 as shown here. The two parts of the valve disk 1, 2 may be joined by welding, gluing, molding-on or be directly deep-drawn to form an integral component as illustrated in Fig. 2. The rim 19 of the valve disk located away from the pressurized container not shown here is appropriately bent over for attachment to said container.

Fig. 2 is a section through a valve in accordance with the invention that coincides with the one illustrated in Fig. 1 as far as a number of significant characteristics are concerned. The valve disk 1, 2 performing its two functions of serving as a cover for the pressurized container and as valve body has been deep drawn in this case to form an integral part. For stiffening purposes and to keep the thickness of the deep-drawn material within reasonable limits a backing element 20 may be provided as shown here. Another difference with respect to the valve shown in Fig. 1 is the leaf spring 21 mounted on the side of the valve disk 1, 2 that faces the pressurized container. Due to the compressive spring force acting on the movable valve element 3, 4 said element is brought and held in closing position. To open the valve due to external pressure being applied the tongue 22 provided in the center of the compression spring and made of a resilient material in a width appropriate to the valve closure element is pressed into the interior of the pressurized container. This clears the annular opening 11 between valve seat 6 and sealing face 7 of the valve closure element on side A as shown in Fig. 2 and thus permits medium to be discharged.

Fig. 3 shows another preferred embodiment of the invention providing for the valve disk 1 to serve both as valve body or guidance 8 for the closure part 4 and with its section 6 as valve seat for sealing element 7.

In a manner already described the valve disk 1 has been bent over in its rim area 9, 10 to enable attachment to the dome of the pressurized container. The valve disk has a folded inner structure terminating in a tubular guide element 8

bent upwardly. The stem 4 is supported within the guide element 8 and in its upper part has been provided with a ring seal 18 mounted in a groove. Said ring seal serves to seal off the system in the event a customary spray gun is mounted (connection elements have not been shown).

The sealing function in fact is the result of an interaction of the horizontal section 6 of valve disk 1 (valve seal 6) to which the subjacent elastic element 17 in the form of a perforated sealing disk is connected. The closure part 4 (stem) is arranged to pass through the sealing disk 17. Immediately below the sealing disk 17 there is the horizontally projecting rim 31 of a spring element 30 retaining the valve in closed position. Sealing disk 17 and rim 31 are joined by crimping at 32 over the entire circumference in a fold of the valve disk 1 so as to form a tight seal.

At its bottom end spring element 30 is provided with a leaf spring or spring tongue 21 that presses the sealing element 7 against the sealing disk 17 and in this way brings about the closing action of the valve. The spigots 33 of sealing element 7 engage with the stem 4 at its bottom end so that a tight seat is achieved. Furthermore, stem 4 has one or more transversely arranged bores 13 through which the foaming agent may enter and exit via the duct provided therein. Stem 4 and sealing element 7 together form the closure part 4.

The valve proper is actuated by pushing down the closure part 4. The pressure is transferred via the sealing element 7 on to the spring tongue 21 which yields and thus clears an annular gap at 11 through which foaming agent may enter the interior of sealing element 7.

It is understood that the spring element 30 itself is not suited to prevent foaming agent from coming into contact with sealing element 7; it has been provided with one or several openings through which the foaming agent may pass freely.

Fig. 4 is a sectional view of another preferred valve embodiment providing for the elastic element 17 for sealing purposes to be designed to form an elastic and tight guiding element 16, in a sectional representation showing intersecting planes offset from each other. The closure element 4 in this case is of one-piece

construction, i.e. it comprises both the stem and the sealing element 7 forming an integral component. A central duct 14 has side openings 13 in its lower portion and is thus open outwardly so that when pushing stem 4 downward said openings 13 are cleared and allow passage into the pressurized container.

The valve disk 1 itself is provided with an area 6 of mainly horizontal configuration and serving as valve seat on which the elastic element 17 acts, as well as a vertically arranged guiding area 8 that engages with a recess provided in the elastic body 16. The elastic body 16 proper is made of rubber or caoutchouc, for example, and designed to form a cylindrical hollow body provided with incisions in the area of the guide 8. It has a primarily smooth inner surface that performs a sealing action where it contacts the outer wall of stem 4 and serves as guide for stem 4 when the valve is actuated by pushing it down.

The sealing area or the sealing element 7 of the closure part 4 is retained in closed position by action of the spring tongue 21 of a spring element 30, i.e. a radial projection of sealing element 7 is pressed against the bottom edge of the elastic element 17 which in turn rests on the valve seat portion 6 of valve disk 1.

The spring element 30 in this case engages with an S-shaped structure of the valve disk 1 (at 32) in a form-closed manner.

The functional method illustrated enables the valve to be manufactured in a simple manner in that, at first, the elastic body 16 is inserted into the valve disk 1 and, subsequently, the stem 4 with sealing element 7 is inserted into said body from below. Following this, the spring element 30 is inserted from below and latched into the S-shaped segment 32 of valve disk 1 where it is retained in a form- and force-closed manner.

Fig. 5 shows another embodiment of the valve according to the invention including stem 4 forming the closure part together with sealing element 7 and the valve disk 1 which in this case as well is designed to comprise of a guide 8 and a valve seat section 6 on which the sealing element 7 acts via a sealing disk 17. Stem 4 has in its lower portion a transversely arranged opening 13 in its wall through which foaming agent is permitted to enter the vertically arranged

duct 14 of the stem 4. An O-ring 18 mounted in a groove serves as sealing element for a spray gun adapter that may be connected in the upper area of the stem 4.

Same as illustrated in Fig. 3 the sealing disk 17 of this embodiment is attached to the valve disk 1 by crimping. However, this embodiment does not provide for the spring element 30 to be connected to sealing disk 17 by crimping but instead has a basket 38 with rim 39 attached to said disk by crimping with said basket 38 being provided with openings 37 through which foaming agent may ingress. In the bottom portion of the basket the spring element 30 is arranged and has a spring tongue 21 projecting upwards and acting on the sealing element 7.

On the inner side of basket 38 vertically arranged webs 3, 4 are located that interact with vertically arranged rim area 36 of the sealing element 7 in such a way that the sealing element 7 is guided within the basket 38.

The spring elements employed in accordance with the invention are preferably made of customary spring steel material. Sealing elements 7 may be designed either as metallic deep-drawn components or as precision moldings made of plastic material. As shown in Fig. 5 basket 38 is preferably made of plastic material.

Fig. 5a is a perspective sectional view of the embodiment illustrated in Fig. 5 and elucidates the interaction of the individual functional components.

The embodiment as per Fig. 6 represents a variant of the embodiment as per Fig. 5 and provides for the sealing disk 17 to be integrated into a sealing body 16.

Valve disk 1 has a valve seat portion 6 and a guiding tube 8 and accommodates a sealing body 16 the bottom end of which being designed so as to form a radially extending sealing disk 17. In its upper portion sealing body 16 shows a projection and a receding portion in the middle in the area of the guiding part 8

of the valve disk 1. That portion of body 16 that rests on the end of guide tube 8 of valve disk 1 is designed elastically in such a manner that it is capable of moving outwardly when pressure is applied to it.

Stem 4 of the valve extends inside the sealing body 16 and together with sealing element 7 forms the closure part. A radial projection provided in its upper area rests on the end of sealing body 16. Stem 4 terminates in a bottom part 39 appropriately fitted into the bowl- or trough-shaped sealing element 7. A full perimeter radial projection 40 contacts sealing disk 17 providing a tight seal.

The lateral openings 13 are shaped as upside-down triangles which enables a very precise dosing of the exiting foaming agent flow when pushing stem 4 down. Initially, only the pointed lower area of the openings 13 is cleared which results in the passing and exiting media volume to be greatly limited. Now, if the stem 4 is pushed down just partially only the lower part of the cross sectional area of openings 13 is cleared so that only a relatively small foaming agent volume is allowed to exit. As the stem is further or completely pushed down the unobstructed area of the openings 13 becomes larger resulting in the discharging capacity of the valve to increase.

Same as shown in Fig. 4 this embodiment also has a spring element 30 with bent-over ends 31 fitted into an S-shaped structure 32 of the valve disk 1 in a form- and force-closed manner. A spring tongue 21 projects upwards and acts on the bottom of sealing element 7 the upper rim of which contacting and providing a sealing action at the radial extension 17 of sealing body 16. It is understood that the spring element 30 has apertures or openings through which the foaming agent may freely enter the space above the spring element.

The valves according to the invention may be employed for all forms of pressurized containers with foaming agents, they are, however, primarily suited for one-component systems. The pressurized containers for such systems are of customary design and do not require any further adaptation to the characteristics of these valves.

It is understood that one of the characteristics of the valves according to the invention is that the valve disk 1 also performs the function of the rigid valve body provided for and existing in customary valves. It is to be noted that aside from the closure part which as a rule consists of the stem and the sealing element but may, as appropriate, be of one- or two-component design only one elastic element is required which is located between valve seat and sealing element and in fact brings about the sealing action proper. In particular, the elastic element is designed as a sealing disk and is preferably secured to the valve disk 6 in the area of the valve seat 6 by flanging/bending, crimping or clamping.

- Claims -